

Center for Dark Energy Biosphere Investigations (C-DEBI)



NSF Directors meeting
Aug. 31 - Sept. 1 2010



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UNIVERSITY OF
ALASKA
FAIRBANKS

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of HAWAII
MĀNOA

THE UNIVERSITY OF
OF RHODE ISLAND SOUTHERN CALIFORNIA

C-DEBI

A center for resolving the extent, function, dynamics and implications of the Subseafloor Biosphere

Explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins

Motivations

History

Goals

An internationally
coordinated
distributed center



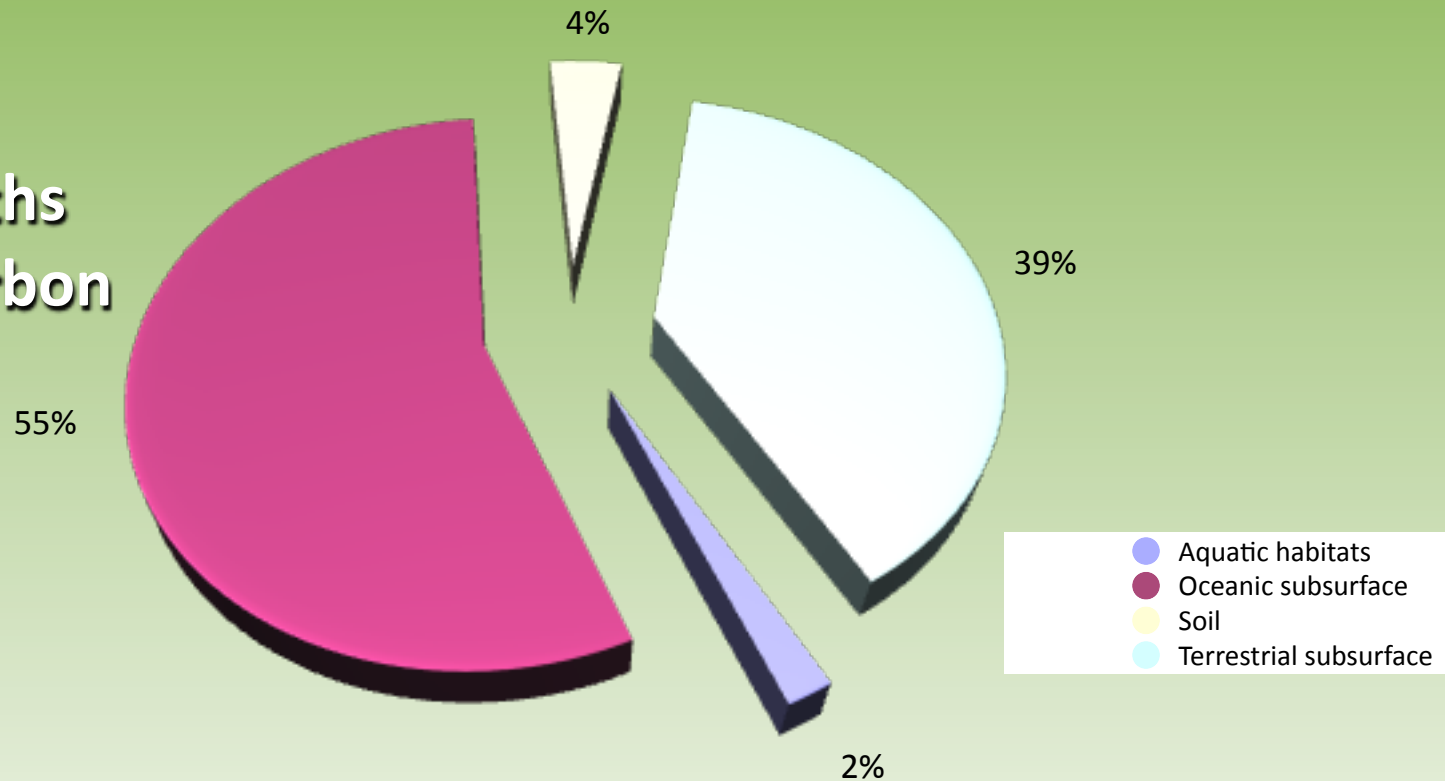
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A Global Census Reveals a Hidden Majority: the Intraterrestrials

Number of prokaryotic cells, $\times 10^{28}$ (bacteria + archaea)

~1/3 of Earth's
biomass carbon



Whitman *et al.*, PNAS 1998



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A Hidden Majority?

Are they **alive**?

Who is there?

What are they **doing**?

Consequence for the Earth system?

Does their influence scale to these vast numbers and habitat size?

Carbon, nitrogen, iron, sulfur global biogeochemical cycles etc.



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Subseafloor Microbes Matter

Example of planetary consequences:
Subseafloor methane production



- *Methane produced by subseafloor microbes has and will influence Earth's climate*
- *Constitutes the largest untapped fossil fuel reservoir on Earth*



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Historical Perspective

- IODP: Integrated Ocean Drilling Program: 2003-2013
- ODP: Ocean Drilling Program: 1983-2003
- DSDP: Deep-sea Drilling Project: 1966-1983



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WHY C-DEBI?

Explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins

- **TWO DECADES** of field, laboratory, theoretical research in labs around the world
- **ONE** major microbiology field project (ODP leg 201) drilled to date
- **THREE** IODP microbiology field projects are scheduled with US leads (2010-2011)



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WHY C-DEBI?

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- ***Capitalize*** on opportunity
- ***Maximize*** scientific return
- ***Bundle, integrate, extend***
- ***Educate, outreach: build the future***



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C-DEBI Technology, Engineering: Tools for the “missions” to our “moon”

CORK Bodies, Casing Hangers



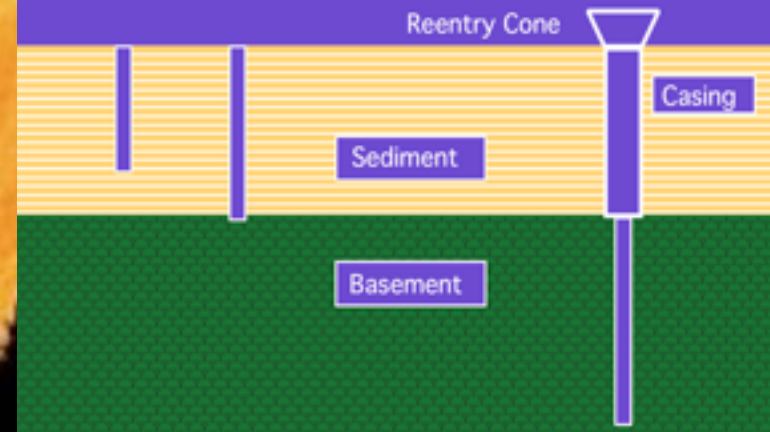
Types of Drill Holes

Most Holes Are SINGLE-BIT HOLES

To recover sediments, possibly upper basement; abandoned after drilling.

A Few Holes Are REENTRY HOLES

To allow bit changes, deep penetration, and post-drilling experiments



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NNE

North Pond, western flank of Mid-Atlantic Ridge

SW

*Note 3-D array is
not shown

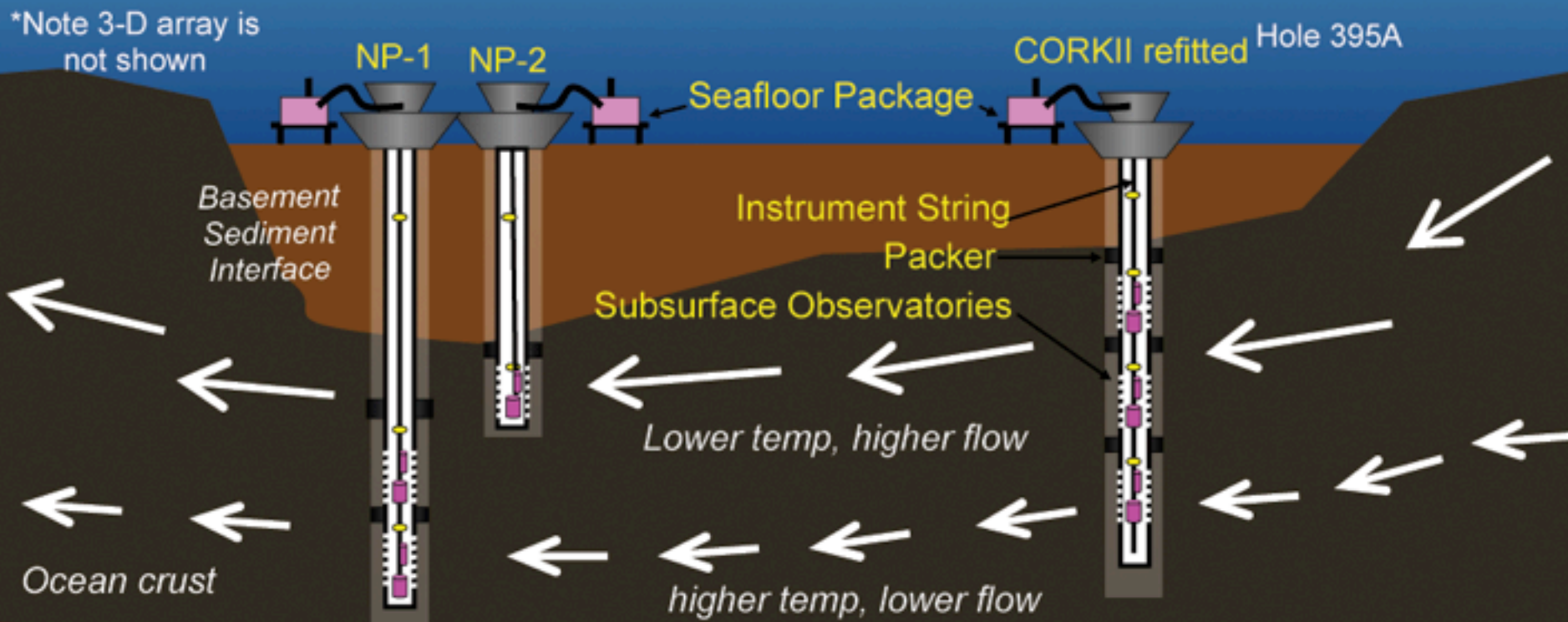


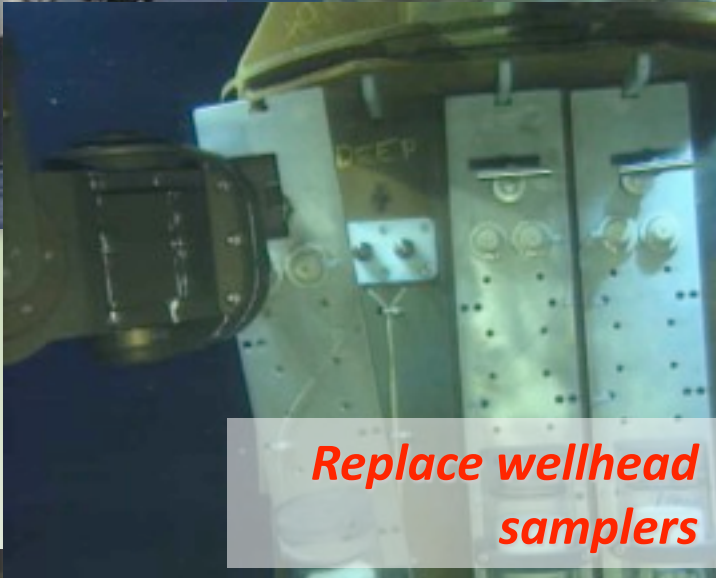
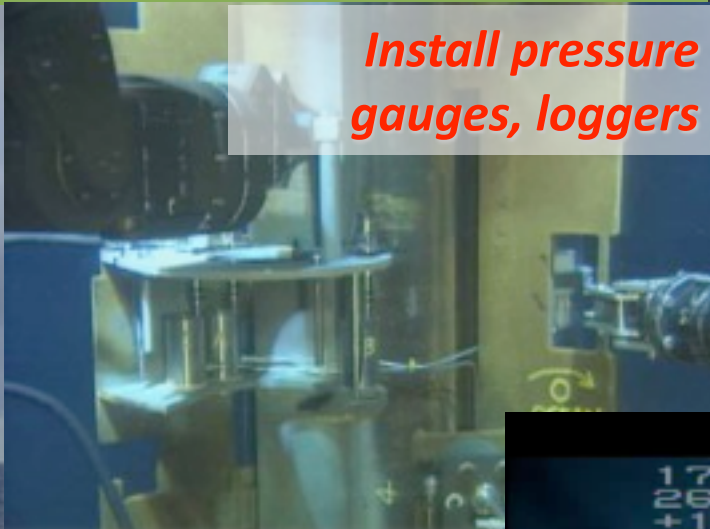
Image adapted from figures by E. Davis, K. Becker, Langseth et al.



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CORK Servicing: multi-decade experiments



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Greetings from Expedition
327! Juan de Fuca
Ridge Flank Hydrogeology

adopt a microbe info at:
[sites.google.com/site/adoptamicrobe/
darkenergybiosphere.org](https://sites.google.com/site/adoptamicrobe/darkenergybiosphere.org)



Center for Dark Energy Bioscience
STC Directors Meeting, Nat

Education, Outreach & Diversity

- Broad range of programs K-grey

- Focus on our sea-going and technology (e.g., robotics) strengths

- Have FUN with our programs (i.e., adopt a microbe)

- PROMOTE to general public the coolness factor of what we do

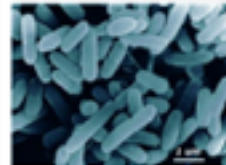
Adopt A Microbe from the Deep Biosphere

Home
Adoption Center
Adoption Details
Background
Giant Microbe updates
Latest Activities
The Team
Project Timeline
Contact Us

2

days until
week 8 project announced

ADOPTION CENTER



Check out the microbes that are up for adoption.

Learn More

JR Cruise Blog

Where is the ship now?



[Giant Microbe updates >](#)

Third letter from Mario

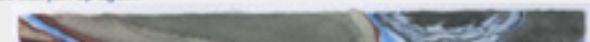
posted 7 hours ago by Beth Orcutt

Greetings, microbe friends! Here's another letter from [Mario the Marinobacter](#), which gives little insight into the unique [tricer experiment](#) that the scientists were conducting yesterday -- [SAM](#)

So I'm hanging out in the pore space, all glommed on to a particle of rock with some other expat [Marinobacter aquaevalis](#), and we're trading stories about the life back in the surface ocean, when all of a sudden, the ground starts to shake and then things go nuts. A giant pipe comes down right past where we are chilling, and the next thing I know, the pipe stops and out comes a rush of water filled with [rare earth](#) salts (yum!), [sulfur hexafluoride](#) gas (eh), and bright [fluorescent particles](#) (which make the most excellent flagellum soccer balls), followed by a slime of glowing bacteria. I'm sitting there watching all of this stuff stream by, and guess who I see? It's [Lenny](#)! He's stained bright yellow, and he's mixed in with all the other stuff being pumped into the rock.



I barely get a look at him and then he's gone, heading off along a big fracture towards the northeast. I don't have much time to think and I have to make a fast decision, so I release from the particle I'm holding and flagellate my way into the stream of funny water, going with the flow. I know that Lenny would do the same for me. Now you might think that a big fracture in bubbly rock is pretty continuous, but it's not. It goes this way and that way, getting thinner and wider, breaking off into other fractures that join up again.



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One Example: GEM

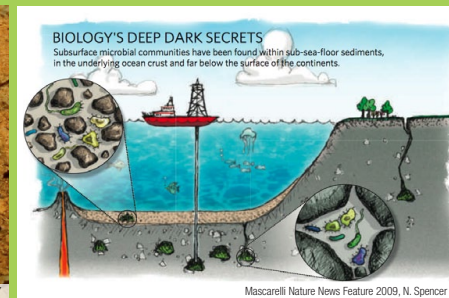
- Summer Minority Program in Microbiology
- 3 weeks on USC campus, 3 weeks on Catalina Island
- Hands-on experience opportunities in the field, lab in environmental micro
- Guidance on career tracks in science, policy, and more



Center for Dark Energy Biosphere Investigations

Resolving the extent, function, dynamics and implications of the subseafloor biosphere

Global Environmental Microbiology (GEM) Underrepresented Minority Summer Course 2011



Studying Microbes is Fun...Seriously!

Microbes are the beginning and end for almost every process on earth! From hydrothermal vents at the bottom of the ocean, to tropical rainforests near the equator, and from the North to South Pole, microbiologists uncover their secrets.

Don't you want to come exploring? You don't have to travel that far—only off the coast of California to Catalina Island. In partnership with the National Science Foundation, the Center for Dark Energy Biosphere Investigations (C-DEBI) will offer a course in microbiology and microbial ecology. Taught by Drs. Eric Webb and John Heidelberg this field-based, hands-on course will be:



- Offered at the University of Southern California
- Four weeks in length in the Summer of 2011
- Weeks 1 and 2 at USC with lectures and lab
- Weeks 3 and 4 at the Wrigley Marine Science Center on Santa Catalina Island
- Field trips to La Brea tar pits, mountains, sewage plants and Long Beach Aquariums



So come and get your "feet wet" in microbial ecology and learn what bacteria are, how they work, and what they do. Explore DNA, genetics and genomics and their potential function in the environment. Figure out how microbes are used—not just for wine and cheese.

Course Contacts: John Heidelberg • jheidelberg@usc.edu; 310-510-4040
Eric Webb • eawebb@usc.edu; 213-740-7954

For additional course information please visit the Dark Energy Biosphere website:
<http://darkenergybiosphere.org>

<http://darkenergybiosphere.org>



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Dark Energy Ecosystems

Ecosystems that exist in the dark - one or more steps removed from photosynthesis that drives the surface world...

- ➡ In physical cosmology - dark energy and dark matter account for the majority “missing matter” in the universe
- ➡ On planet Earth, life buried beneath its surface may account for the majority of biomass carbon



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